

What is claimed are:

1. A variable valve control apparatus for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising:
  - a first calculating section that calculates an amount of fresh air flown into a cylinder of said engine;
  - a second calculating section that calculates a gas amount spit-back to an intake side from the inside of the cylinder when said intake valve is opened;
  - a third calculating section that calculates said gas amount passing through said intake valve based on said fresh air amount and an amount of predetermined times the spit-back gas amount of the time when said intake valve is opened; and
  - a control section that controls said variable valve mechanism based on said gas amount passing through said intake valve.
2. A variable valve control apparatus for an internal combustion engine according to claim 1, further comprising:
  - a fourth calculating section that calculates a gas amount spit-back to the intake side when said intake valve is closed,
  - wherein said third calculating section calculates the gas amount passing through said intake valve based on the amount of predetermined times the spit-back gas amount of the time when said intake valve is opened, said fresh air amount and the spit-back gas amount of the time when said intake valve is closed.
3. A variable valve control apparatus for an internal combustion engine according to claim 1,
  - wherein said third calculating section calculates the gas amount passing through said intake valve based on an amount of two times the spit-back gas amount of the time when said intake valve is opened and said fresh air amount.
4. A variable valve control apparatus for an internal combustion engine according to claim 1,
  - wherein said first calculating section calculates said fresh air amount based on a requested torque;
  - said second calculating section calculates the spit-back gas amount of the time when said intake valve is opened, based on a requested residual gas rate;
  - said third calculating section calculates a requested valve passing gas amount, based on an amount of predetermined times the spit-back gas amount of the time when said

intake valve is opened and said fresh air amount; and

said control section sets a target operating characteristic of said intake valve based on said requested valve passing gas amount, to control said variable valve mechanism based on said target operating characteristic.

5. A variable valve control apparatus for an internal combustion engine according to claim 4,

wherein there are provided, as said variable valve mechanism, a variable valve event and lift mechanism that successively varies a valve lift of said intake valve together with an operating angle of said intake valve, and a variable valve timing mechanism that successively varies a center phase of the operating angle of said intake valve; and

said control section calculates requested closing timing of said intake valve, at which said requested valve passing gas amount can be obtained, when an opening area of said intake valve is a predetermined value;

calculates requested opening timing of said intake valve based on said requested residual gas rate and said predetermined opening area;

sets, as a control target of said variable valve event and lift mechanism, a valve lift or an operating angle which satisfies, with said predetermined opening area, an operating angle obtained based on said requested closing timing and requested opening timing; and

sets a control target of said variable valve timing mechanism so as to satisfy said requested closing timing and requested opening timing.

6. A variable valve control apparatus for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising:

a storage section that stores previously a correlation between a value equivalent to an opening area of said intake valve and a valve passing gas amount, corresponding to predetermined effective cylinder capacity;

a conversion section that converts said value equivalent to the opening area of said intake valve into the valve passing gas amount by referring to said correlation;

a correction section that corrects said value equivalent to the opening area based on a ratio between the valve passing gas amount obtained in said conversion section and a requested valve passing gas amount;

a calculating section that calculates requested effective cylinder capacity by which said requested valve passing gas amount can be obtained based on said value equivalent to the opening area, based on the valve passing gas amount obtained by referring to said correlation based on the value equivalent to the opening area corrected in said correction section, and said requested valve passing gas amount; and

a control section that controls said variable valve mechanism according to the requested effective cylinder capacity calculated in said calculating section.

7. A variable valve control apparatus for an internal combustion engine according to claim 6,

wherein there are provided, as said variable valve mechanism, a variable valve event and lift mechanism that successively varies a valve lift of said intake valve together with an operating angle of said intake valve, and a variable valve timing mechanism that successively varies a center phase of the operating angle of said intake valve; and

said control section calculates requested closing timing of said intake valve based on said requested effective cylinder capacity;

calculates requested opening timing of said intake valve based on a requested residual gas rate and said value equivalent to the opening area;

sets, as a control target of said variable valve event and lift mechanism, a valve lift or an operating angle which satisfies an operating angle obtained based on said requested closing timing and requested opening timing of said intake valve, at said value equivalent to the opening area; and

sets a control target of said variable valve timing mechanism so as to satisfy said requested closing timing and requested opening timing.

8. A variable valve control apparatus for an internal combustion engine according to claim 6,

wherein said value equivalent to the opening area of said intake valve is a value obtained by correcting the opening area of said intake valve with an engine rotation speed and a piston displacement.

9. A variable valve control apparatus for an internal combustion engine according to claim 6, further comprising;

a requested amount calculating section that calculates said requested valve passing gas amount based on a fresh air amount, a spit-back gas amount of the time when said intake valve is opened and a spit-back gas amount of the time when said intake valve is closed.

10. A variable valve control apparatus for an internal combustion engine according to claim 6,

wherein said storage section stores previously the correlation between said value equivalent to the opening area of said intake valve and said valve passing gas amount, corresponding to the time when the effective cylinder capacity is 100%.

11. A variable valve control apparatus for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising:

first calculating means for calculating an amount of fresh air flowing into a cylinder of said engine;

second calculating means for calculating a gas amount spit-back to an intake side from the inside of the cylinder when said intake valve is opened;

third calculating means for calculating said gas amount passing through said intake valve based on said fresh air amount and an amount of predetermined times the spit-back gas amount of the time when said intake valve is opened; and

control means for controlling said variable valve mechanism based on said gas amount passing through said intake valve.

12. A variable valve control apparatus for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising:

storage means for storing previously a correlation between a value equivalent to an opening area of said intake valve and a valve passing gas amount, corresponding to predetermined effective cylinder capacity;

conversion means for converting said value equivalent to the opening area of said intake valve into the valve passing gas amount by referring to said correlation;

correction means for correcting said value equivalent to the opening area based on a ratio between the valve passing gas amount obtained by said conversion means and a requested valve passing gas amount;

calculating means for calculating requested effective cylinder capacity by which said requested valve passing gas amount can be obtained based on said value equivalent to the opening area, based on the valve passing gas amount obtained by referring to said correlation based on the value equivalent to the opening area corrected by said correction means, and said requested valve passing gas amount; and

control means for controlling said variable valve mechanism according to the requested effective cylinder capacity calculated by said calculating means.

13. A variable valve control method for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising the steps of:

calculating an amount of fresh air flowing into a cylinder of said engine;

calculating a gas amount spit-back to an intake side from the inside of the cylinder when said intake valve is opened;

calculating said gas amount passing through said intake valve based on said fresh air amount and an amount of predetermined times the spit-back gas amount of the time when said intake valve is opened; and

controlling said variable valve mechanism based on said gas amount passing through said intake valve.

14. A variable valve control method for an internal combustion engine according to claim 13, further comprising the step of;

calculating a gas amount spit-back to the intake side when said intake valve is closed,

wherein said step of calculating the gas amount passing through said intake valve calculates the gas amount passing through said intake valve based on the amount of predetermined times the spit-back gas amount of the time when said intake valve is opened, said fresh air amount and the spit-back gas amount of the time when said intake valve is closed.

15. A variable valve control method for an internal combustion engine according to claim 13,

wherein said step of calculating the gas amount passing through said intake valve calculates the gas amount passing through said intake valve based on an amount of two times the spit-back gas amount of the time when said intake valve is opened and said fresh air amount.

16. A variable valve control method for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising the steps of:

calculating an amount of fresh air flown into a cylinder based on a requested torque;

calculating a gas amount spit-back to an intake side from the inside of the cylinder when said intake valve is opened, based on a requested residual gas rate;

calculating a requested gas amount passing through said intake valve, based on an amount of predetermined times the spit-back gas amount of the time when said intake valve is opened and said fresh air amount;

setting a target operating characteristic of said intake valve based on said requested valve passing gas amount; and

controlling said variable valve mechanism based on said target operating characteristic.

17. A variable valve control method for an internal combustion engine according to claim 16,

wherein there are provided, as said variable valve mechanism, a variable valve event and lift mechanism that successively varies a valve lift of said intake valve together with an operating angle of said intake valve, and a variable valve timing mechanism that successively varies a center phase of the operating angle of said intake valve; and

said step of controlling said variable valve mechanism comprises the steps of:

calculating requested closing timing of said intake valve, at which said requested valve passing gas amount can be obtained, when an opening area of said intake valve is a predetermined value;

calculating requested opening timing of said intake valve based on said residual gas rate and said predetermined opening area;

setting, as a control target of said variable valve event and lift mechanism, a valve lift or an operating angle which satisfies, with said predetermined opening area, an operating angle obtained based on said requested closing timing and requested opening timing; and

setting a control target of said variable valve timing mechanism so as to satisfy said requested closing timing and requested opening timing.

18. A variable valve control method for an internal combustion engine provided with a variable valve mechanism that varies an operating characteristic of an intake valve, for controlling a gas amount passing through said intake valve by variably controlling said operating characteristic, comprising the steps of:

storing previously a correlation between a value equivalent to an opening area of said intake valve and a valve passing gas amount, corresponding to predetermined effective cylinder capacity;

converting said value equivalent to the opening area of said intake valve into the valve passing gas amount by referring to said correlation;

correcting said value equivalent to the opening area based on a ratio between the converted valve passing gas amount and a requested valve passing gas amount;

calculating requested effective cylinder capacity by which said requested valve passing gas amount can be obtained based on said value equivalent to the opening area, based on the valve passing gas amount obtained by referring to said correlation based on the corrected value equivalent to the opening area, and said requested valve passing gas amount; and

controlling said variable valve mechanism according to the requested effective cylinder capacity calculated.

19. A variable valve control method for an internal combustion engine according to claim

18,

wherein there are provided a variable valve event and lift mechanism that successively varies a valve lift of said intake valve together with an operating angle of said intake valve, and a variable valve timing mechanism that successively varies a center phase of the operating angle of said intake valve, as said variable valve mechanism; and

said step of controlling said variable valve mechanism comprises the steps of:

calculating requested closing timing of said intake valve based on said requested effective cylinder capacity;

calculating requested opening timing of said intake valve based on a requested residual gas rate and said value equivalent to the opening area;

setting, as a control target of said variable valve event and lift mechanism, a valve lift or an operating angle which satisfies an operating angle obtained based on said requested closing timing and requested opening timing of said intake valve, at said value equivalent to the opening area; and

setting a control target of said variable valve timing mechanism so as to satisfy said requested closing timing and requested opening timing.

20. A variable valve control method for an internal combustion engine according to claim 18,

wherein said value equivalent to the opening area of said intake valve is a value obtained by correcting the opening area of said intake valve with an engine rotation speed and a piston displacement.

21. A variable valve control method for an internal combustion engine according to claim 18, further comprising the step of;

calculating said requested valve passing gas amount based on a fresh air amount, a spit-back gas amount of the time when said intake valve is opened and a spit-back gas amount of the time when said intake valve is closed.

22. A variable valve control method for an internal combustion engine according to claim 18,

wherein said step of storing the correlation stores previously the correlation between said value equivalent to the opening area of said intake valve and said valve passing gas amount, corresponding to the time when the effective cylinder capacity is 100%.